Sfermion production at a Linear Collider at one-loop

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hep-ph/0311149

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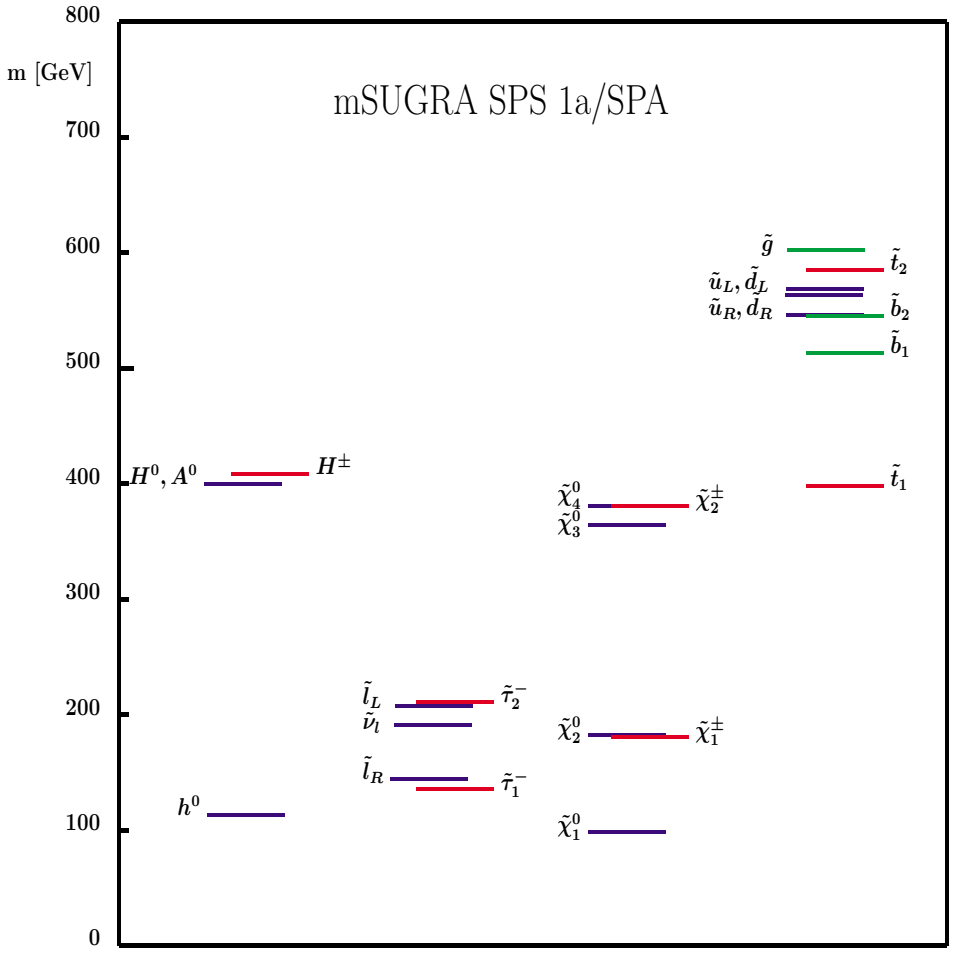
MOTIVATION

- At a future e^+e^- LC measurements with high precision possible $\longrightarrow$ requires accurate theoretical predictions including radiative corrections
- LC allows high precision determination of SUSY parameters
- Sfermion production ideal for determination of sfermion mass matrix parameters
- Some sfermions are expected to be light (e.g. light stop due to large mixing)
- SPS1a scenario includes light sleptons



RADIATIVE CORRECTIONS TO SFERMION PRODUCTION

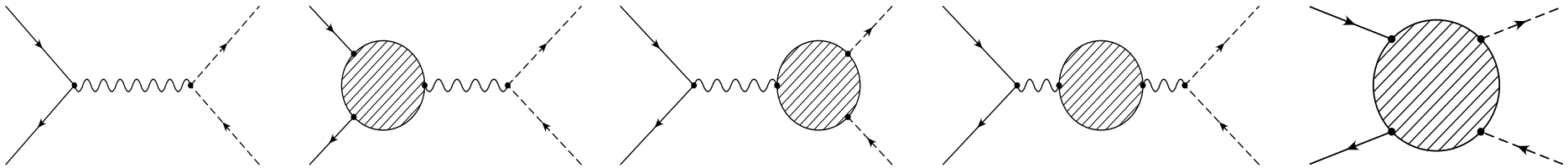
existing results:

- QCD corrections to colored scalar particle production in SM
  [Drees, Hikasa '90]
  [Hikasa, Hisano '96]
- SUSY-QCD corrections to sfermion production within MSSM
  [Arhrib, Capdequi-Peyranere, Djouadi '95]
  [Eberl, Bartl, Majerotto '96]
- Yukawa corrections without box contributions
  [Eberl, Kraml, Majerotto '99]

calculations presented here:

- weak corrections to $e^+e^- \to \tilde{f}_i \bar{\tilde{f}}_j$ for $f = t, b, \tau, \nu_\tau, u, d$
- QED corrections split off
- included already calculated QCD

CALCULATION OF $e^+ e^- \to \tilde{f}_i \, \bar{\tilde{f}}_j$



- all diagrams calculated analytically & checked with FeynArts/FormCalc on amplitude level
- numerical evaluation using LoopTools

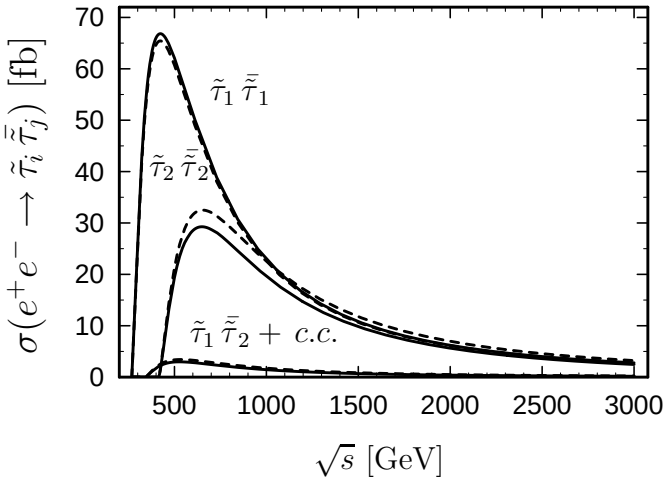
some details

- 't Hooft-Feynman gauge
  $\overline{\rm DR}$ regularization scheme used for UV divergencies
- on-shell renormalization scheme with $\alpha(m_Z)$ as input
- on-shell input parameters for SPS1a obtained from $\overline{\rm DR}$ parameters as

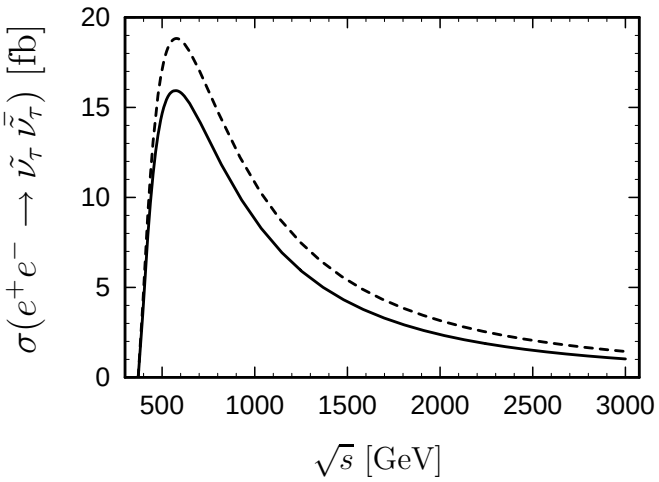
$$X^{OS} = \hat{X}(Q) - \delta X(Q)$$

SLEPTON PRODUCTION (3rd gen.)

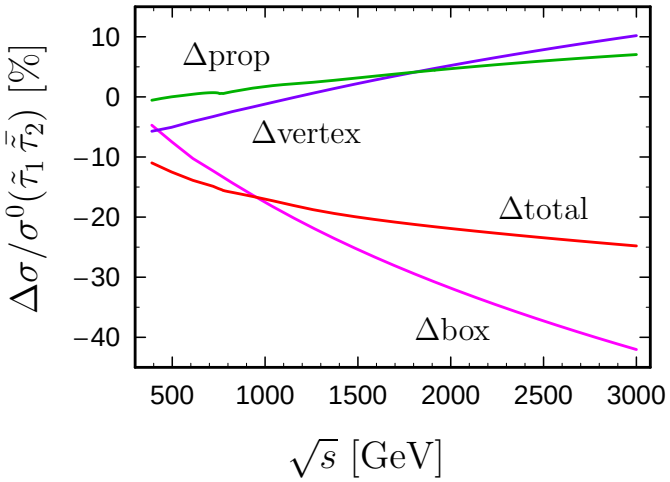
STAUS



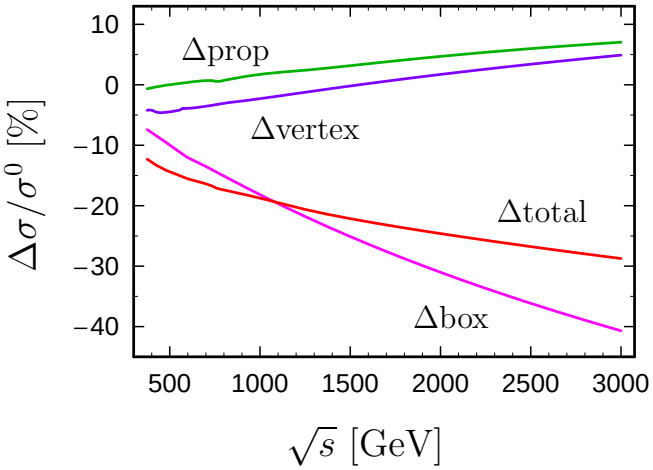
TAU-SNEUTRINO



$\tilde{\tau}_1 \bar{\tilde{\tau}}_2$– RELATIVE

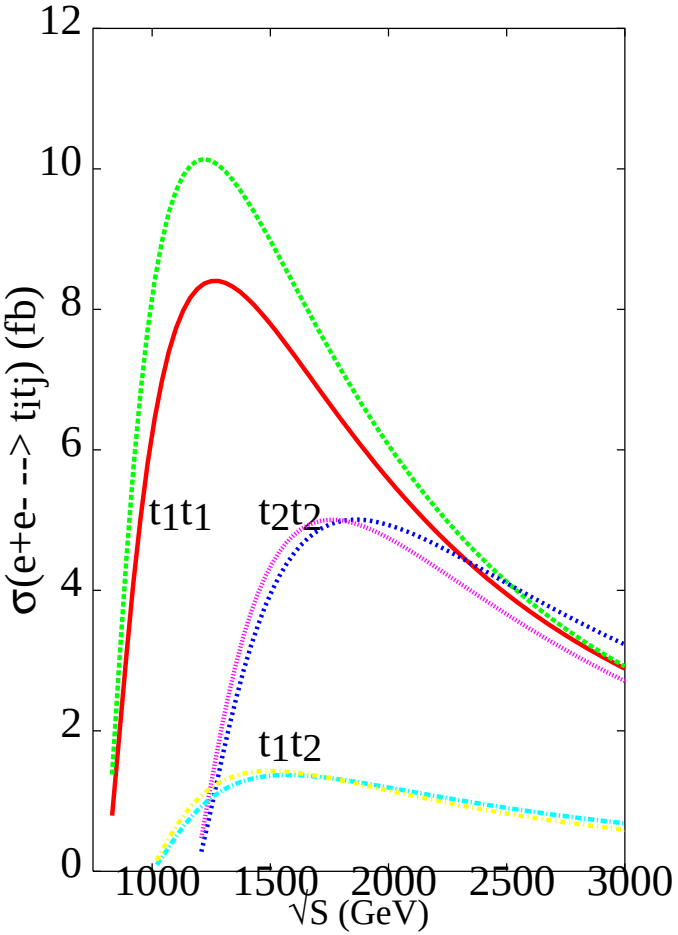


$\tilde{\nu}_\tau \bar{\tilde{\nu}}_\tau$– RELATIVE

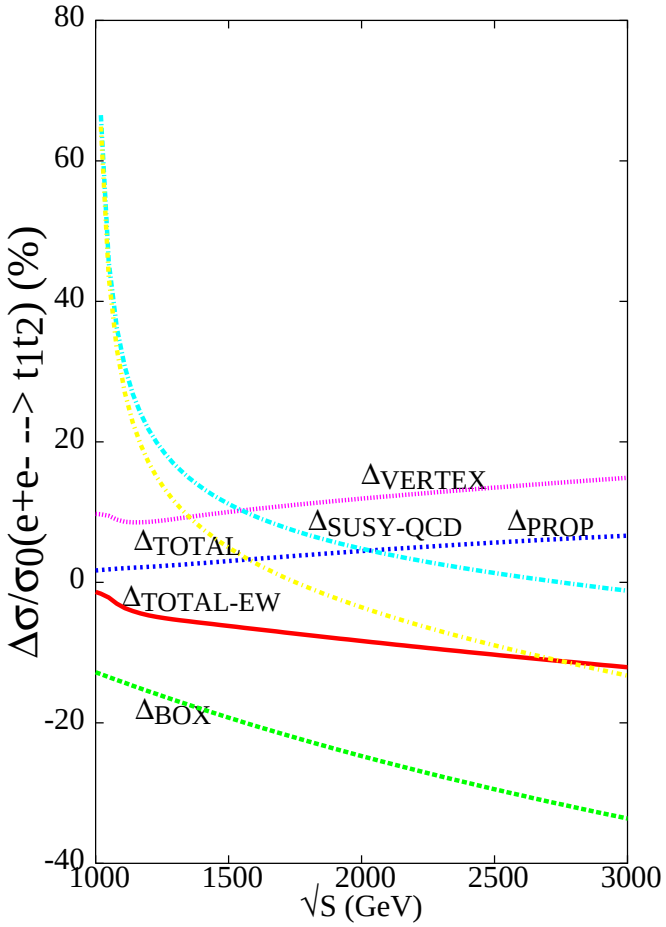


SQUARK PRODUCTION (3rd gen.)

STOPS



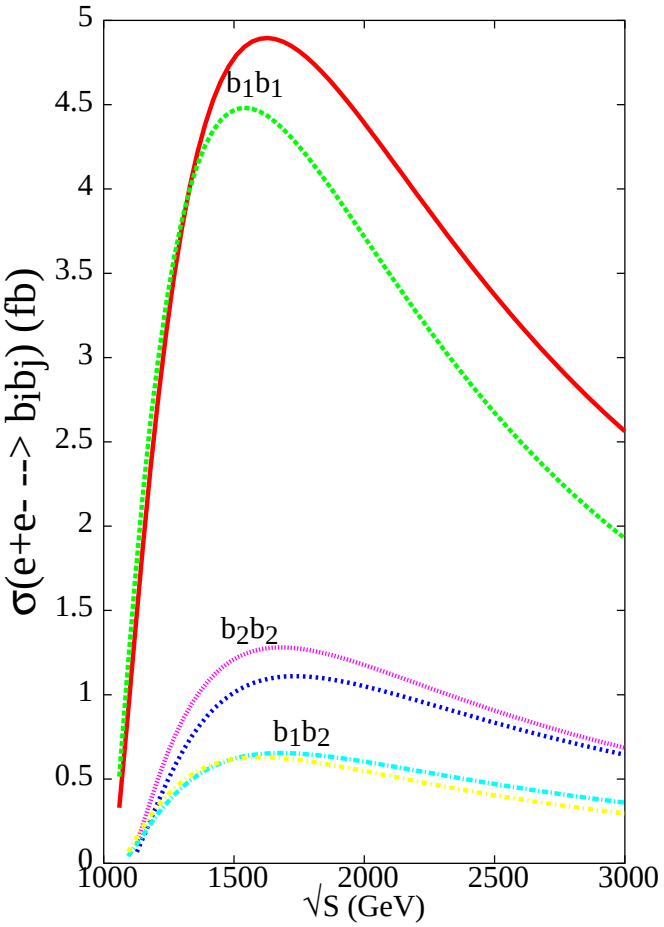
$\tilde{t}_1\bar{\tilde{t}}_2$– RELATIVE



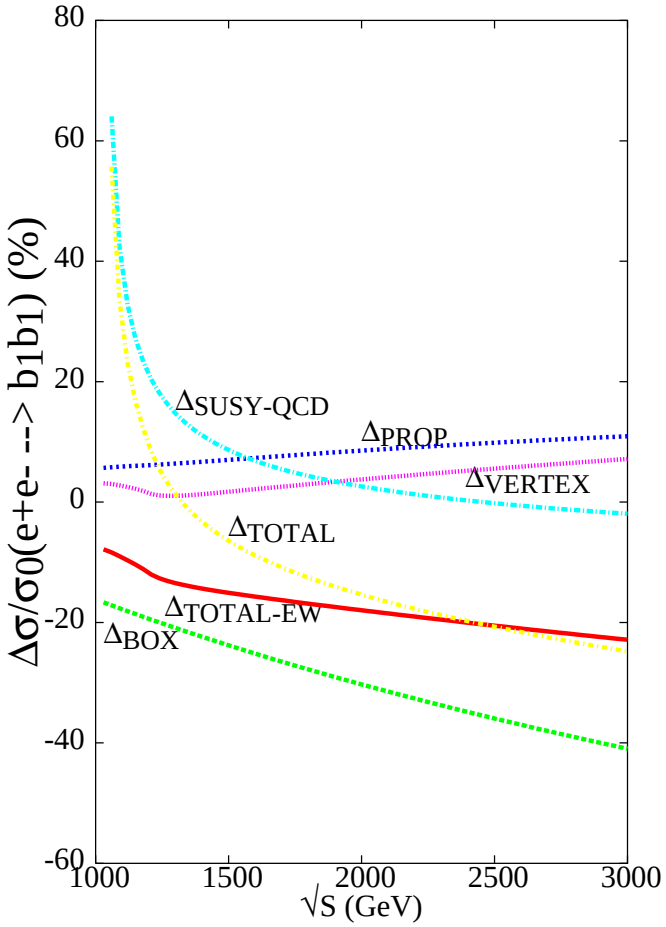
PLOTS FROM A.ARHRIB, W.HOLLIK

SQUARK PRODUCTION (3rd gen.) cont.

SBOTTOMS



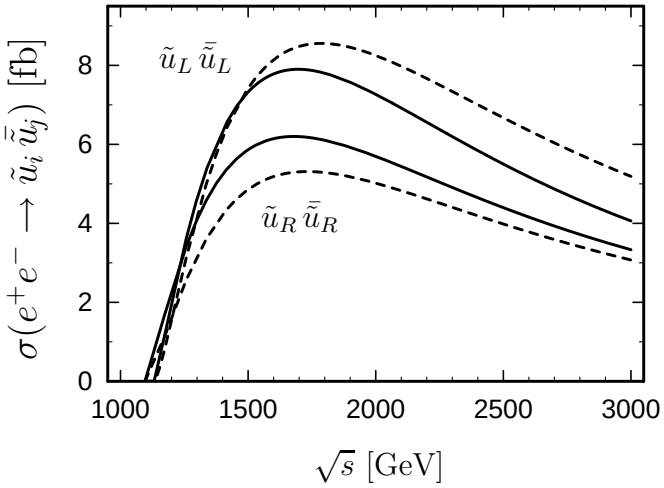
$\tilde{b}_1\,\bar{\tilde{b}}_1$ – RELATIVE



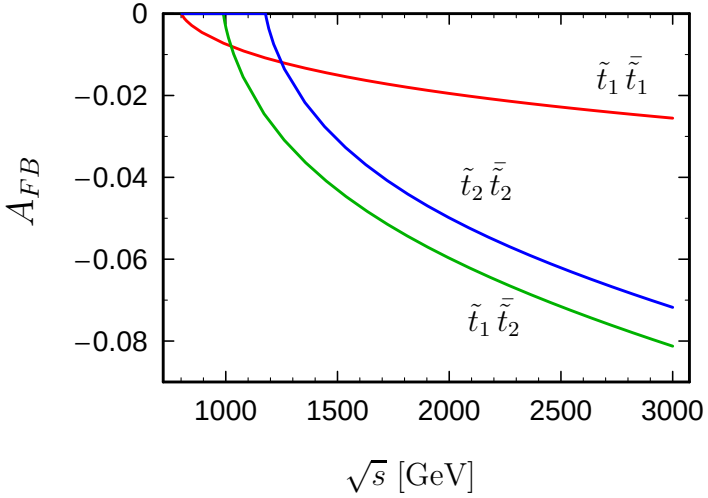
PLOTS FROM A.ARHRIB, W.HOLLIK

SQUARK PRODUCTION (1st & 2nd gen.) + A_{FB} ASYMMETRY

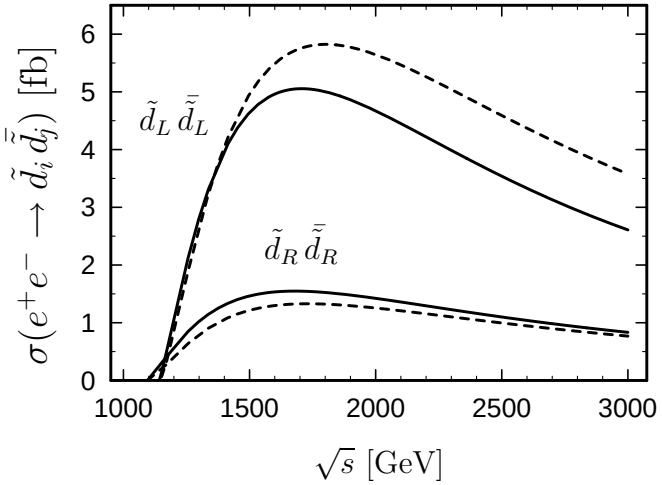
UP-TYPE SQUARKS



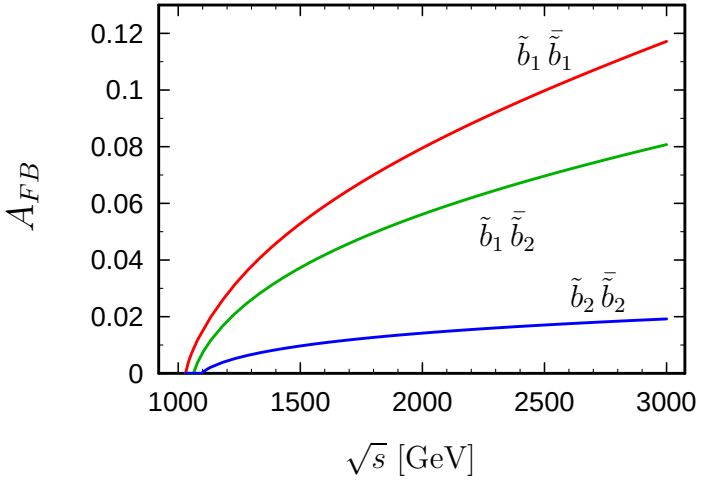
A_{FB} FOR STOPS



DOWN-TYPE SQUARKS

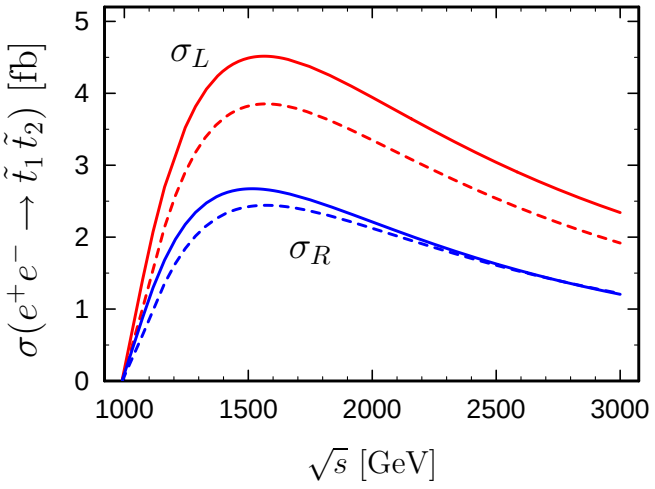


A_{FB} FOR SBOTTOMS

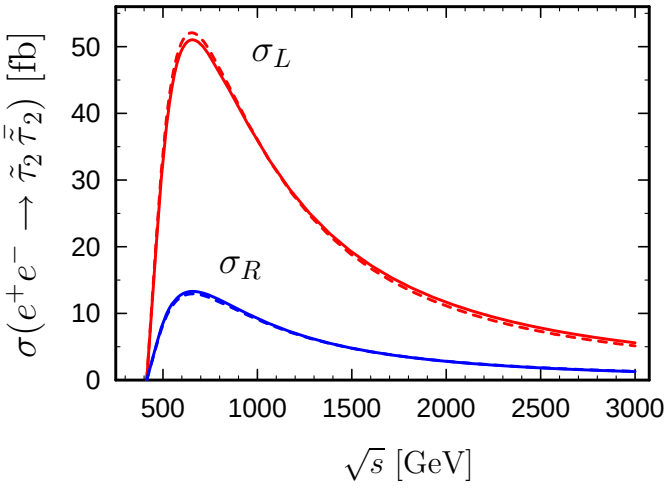


POLARIZATION (e^- beam polarized)

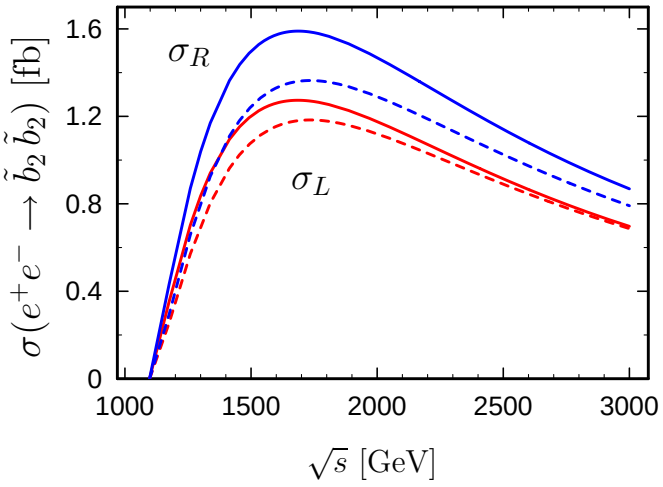
POLARIZED $\tilde{t}_1\,\bar{\tilde{t}}_2$



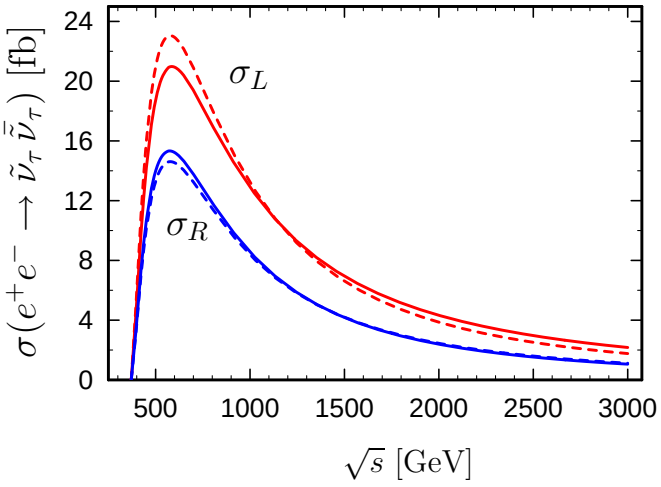
POLARIZED $\tilde{\tau}_2\,\bar{\tilde{\tau}}_2$



POLARIZED $\tilde{b}_2\,\bar{\tilde{b}}_2$



POLARIZED $\tilde{\nu}_\tau\,\bar{\tilde{\nu}}_\tau$



CONCLUSIONS & OUTLOOK

- Sfermion production supposed to be observed at a future LC
- Radiative corrections not negligible ($\sim -10\%$) when high precision results available
- Box corrections are important at high energies
- Sfermion production ideal for sfermion mass matrix parameters fixing

OUTLOOK:

- Full $\mathcal{O}(\alpha)$ corrections - extending current calculation to include full bremsstrahlung